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AN INDUCTIVE STUDY OF THE CONTENT OF GEOGRAPHY.*

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The Need of Comparing Opinions.—One of the objects to which this Association may well direct its attention is the nature of the whole subject of Geography, under whose broad shelter our individual studies are carried on. If we work only in view of our chosen field within the whole area of geography, we lose something of breadth, although we may gain much in depth. Our work will become more serviceable to others if it is presented in such a manner that its relations to the whole subject are made clear. Not only so; we may often benefit ourselves by systematically setting forth the place of our individual studies in geography as a whole, for we may be thereby led to discover that the systematic sequence of parts is interrupted here and there by gaps, which can be filled by well-directed effort. * * * * *

But it is manifest that, if we should attempt to make exposition of our ideas concerning the relation of our own studies to the whole subject, we must have previously gained a tolerably definite idea of the nature of the whole. Very likely we each have some such conception. If so, it would be profitable to institute a collection and a comparison of opinions; though it can hardly be doubted that they would show much diversity.

Examples of Geographical Statements.—As a contribution towards such a collection of opinions, I propose to consider the nature or content of geography in this address; but instead of presenting an abstract definition of the subject, the problem will be regarded from the other side. There will first be presented a number of sample statements that are presumed to

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be geographical because they are taken from geographical works; these statements will then be analyzed in order to discover their essential nature; finally, an attempt will be made to discover the nature of the whole subject of geography on the basis of the statements thus analyzed—that is, to discover the content of geography on the basis of an inductive study. The statements to be presented are taken from a variety of sources—text-books, treatises, and journals; they are often condensed from the original.

Here, for example, is a first set of items or statements: There are three native states in the Himalaya which are independent of British rule.—The rivers of southern Gascony flow in radiating courses.—There are more than 300 asteroids.—The average man has about eighty-seven cubic inches of brain.—The mean depth of the ocean is about two miles.—A new map of France on a scale of 1:50,000 is in course of publication.—Protozoa are the simplest forms of animals, consisting of a single cell.—The magnetic poles do not coincide with the poles of rotation.—Celtic is spoken in Wales, the Highlands of Scotland, and western Ireland.—Cotton is produced in the southern United States.—The fall of rivers is usually greatest in their upper courses.—The Grand Duchy of Prussia became a kingdom in 1701.—Cryptogams are flowerless plants.—The Hindu-kush, the highest mountains of Persia, trend to the northeast.—Australia has many marsupials, of which the kangaroo is the largest.—Amundsen has successfully made the Northwest Passage.

If all these statements are truly of geographical quality, it follows that all similar statements would be of geographical quality also. We should then have, in a complete geography, accounts of all states, in the Himalaya or elsewhere, dependent or independent of British or of other rule; descriptions of the course of rivers in all parts of the world; additional facts about other bodies in the heavens besides the asteroids; accounts of man's other organs than his brain; details as well as averages of ocean depths; descriptions of multicellular as well as of unicellular animals, and of flowering as well as of flowerless plants; reports on old as well as on new maps of France and of all other countries, whatever their scale; other items concerning terrestrial magnetism as well as the position of the magnetic poles; reports of all sorts of voyages; accounts of the changes of all duchies to kingdoms or of kingdoms to duchies, and of other political changes as well; mention of the animals of other lands than Australia, and the products of other countries than our southern States; announcements of voyages in all parts of the world in all centuries.

The Complexity of Geography.—The first impression about so varied a collection of statements would be that the subject under which they are

all properly included must be a sort of *omnium gatherum,* without any well-defined unity of substance. Such, indeed, geography has been thought to be by some critics. A closer examination of our materials must be made to see if we really have to do with a heterogeneous collection of incoherent facts, without continuity of thought or unity of discipline. It may be that some of the items above cited do not justly belong under geography, and that an enchainment not apparent at first may be found to bring the remaining items and their proper fellows into some systematic association.

On reviewing the statements given above it appears that some are concerned with matters remote from the earth and commonly associated with astronomy; that some are concerned with matters of a personal or technical nature; that a third group of statements contains accounts of inorganic features of the earth; and a fourth group, of organic inhabitants of the earth. Let us examine these several classes to see in how far they may be justly considered geographical.

Excepting as an astronomical statement is found to be related to terrestrial matters in such a way as to throw light on them, it should not be considered directly or indirectly geographical, in spite of the mention of such a matter in a geographical text-book; for by common consent geography has to do primarily with the earth. Hence the mere statement of the number of asteroids should be excluded from our consideration. It may, however, be advisable to retain in elementary text-books certain statements concerning planets in so far as they serve to emphasize the globular form of the earth by showing that there are other bodies like it; and such mention of the sun and moon as is needed for the understanding of insolation in relation to climate and of gravitation in relation to tides; and such account of the stars as shall serve in the proof of the rotation of the earth and in the determination of the attitude of its axis. Nevertheless all of these items seem to be only indirectly associated with our subject; they do not aid us to discover the real nature of geography.

Technical and personal items may naturally be associated with geography, if the things and events with which they are concerned are of geographical quality, as maps and explorations certainly are. The announcement of the publication of a new map or of the completion of a remarkable voyage is therefore a piece of appropriate geographical news. Accounts of old maps, of old voyages, and of old ideas are very illuminating in showing how the geography of to-day has been developed; but they belong more with history than with geography when presented in order of time.

Non-Geographical Statements.—Many of the statements under the two remaining classes, which concern inorganic and organic matters on the

earth, are properly geographical, if we judge by the repeated occurrence of such statements in many geographical works. Yet we cannot believe that all statements about inorganic and organic matters on the earth belong under geography. It is easy to instance a number of such statements from geographical sources which can hardly be regarded as having any clear association with geography. Consider, for example, the following set of items, all taken from geographical text-books:

The gastrula stage occurs just before maturity in the sponge.—All substances transmit electrical energy.—Crystallization is explained by supposing that the cohesive force of molecules is not exerted equally on all sides.—After 1810 several independent republics were formed in South America.—The rosaceæ have regular flowers.

However interesting and useful these items of information may be, they can hardly be regarded as geographical, even under the very broadest interpretation of our subject. They have probably been added to the text-books from which they are quoted in the belief that they are worth knowing, and that the pupils in our schools will have little chance of learning them if they are not brought in under the popular subject of geography. I question the advisability of such a method of promoting popular education; but that is another story. Our problem is to distinguish these and many similar statements from a large variety of other statements concerning the inorganic and organic terrestrial matters, so as to know which ones are properly of geographical quality and which ones are not.

Statements involving Relations.—The best solution that I have been able to find for this problem comes from a consideration of such statements as are included in the following third set of extracts which like the other two, have been taken from geographical sources:

The people of the Dalmatian coast are largely engaged as fishermen on the Adriatic; here the Austrian navy obtains its best seamen.—A number of gulfs and mountain ranges naturally divide the people of Europe into groups or nations.—Some parts of Bengal are so favored with rivers that almost every cottage has a navigable stream at its door, and the Bengalese farmer keeps his boat just as the English farmer keeps his gig.—Northern Uganda is drier, rain often fails, grass is short, and dry-country animals, such as zebras and ostriches, abound.—The level land near Lake Titicaca is of small extent, and is occupied by alkaline marshes subject to overflow; for this reason the Indians cultivate the slopes in preference, converting them into narrow terraced garden beds.—The periodic or monsoon winds that blow alternately in one direction and the other along certain coasts, as between India and East Africa, have long been favorable to navigation and

trade.—In northwest France the farmhouses on the chalk uplands are gathered into compact villages around one or more deep wells, because the ground water there is deep below the surface and difficult to obtain; but in the valleys the houses are scattered, because each family can easily procure its own water supply with little trouble.

Geography, a Study of Relations.—These statements differ from some of those of the two earlier groups of citations, in that they each contain at least two kinds of elements, one of which stands in a more or less distinctly causal relation to the other. The statements vary, in that some of the relations suggested are relatively simple while others are more complex; and in that some statements are rather empirical while others are more fully explanatory; but they are all alike, in that they involve a relation of cause and effect, usually between some element of inorganic control and some element of organic response. As such, these statements are examples of the most generally treated material that I can find; and hence I am disposed to say that any statement is of geographical quality if it contains a reasonable relation between some inorganic element of the earth on which we live, acting as a control, and some fact concerning the existence or growth or behavior or distribution of the earth's organic inhabitants, serving as a response; more briefly, some relation between an element of inorganic control and of organic response. The geographical quality of such a relation is all the more marked if the statement is presented in an explanatory form. There is, indeed, in this idea of a causal or explanatory relationship the most definite, if not the only, unifying principle that I can find in geography. All the more reason, then, that the principle should be recognized and acted upon by those who have the fuller development of geographical science at heart.

Geography as the Study of Location or of Distribution.—There still exists in some quarters a tendency to limit geography by definition to the study of location, leaving the study of all things that are located to other subjects. There is so little support for this narrow view of the subject to be found in modern geographical books that it need not be further considered. Another and more widely-accepted definition treats geography as the science of distribution. This is particularly a British view of the subject, and at least one British geographer urges that the distributed things should not be regarded as belonging to geography at all; but his writings are broader than his definition. While location and distribution must always be important elements of geography, all geographical books give much attention to the nature of the things that are distributed, and all recent books give much weight to the relations in which the distributed things

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occur: hence relationship seems to me the primary principle of the two, and distribution takes a secondary rank. The thing must be known before its distribution can be serviceably studied. The division of the peoples of Europe into groups or nations in consequence of the division of Europe by gulfs and mountain ranges is a geographical relation, in which the unlikeness of the things distributed takes precedence of their distribution.

Indeed, if geography is only the science of distribution—that is, the regional aspect of other subjects—it would be hardly worth while to maintain the study of geography apart from that of the subjects whose regional aspect it considers. Moreover, if geography is defined simply as the science of distribution, then the distribution of anything at all is a fit subject for geographical study. Under such a definition the distribution of hypersthene andesite or of books of poetry would be part of our responsibility; but there is nowhere any indication that geographers feel responsible for the distribution of such things. Again, if distribution is given first rank, the regional or spacial occurrence of all sorts of things is thereby given so great an importance that an insufficient place would be left for the systematic consideration of geographical things; yet most books first present things of a kind together—that is, they present the subject systematically—before they take up the distributional or regional treatment of different kinds of things.

As a matter of fact, nearly every example that is presented in this essay as an example of a geographical relation might, if desired, be presented as an example of distribution; and nearly all statements of distribution may be turned around so that they shall enter into or constitute relations; hence the total content of geography would be much the same under either principle. The relations that could not be presented under the lead of distribution are those which are the same everywhere; but it seems to me rather arbitrary to include relations that vary from place to place, and to exclude relations that are world-wide in their uniform occurrence. For example, the composition of the atmosphere or of the ocean, always accepted as an appropriate matter for mention in elementary texts, deserves no place in geography, treated as the science of distribution, until the minute variations of composition from place to place are considered.

In any case, location and distribution are fundamental elements of geography, and maps of the lands and charts of the oceans are essential in its every chapter. In view of the importance of these elements, some are disposed to attach an undue value to surveying as a part of geography. But surveying properly belongs in geography about where writing belongs in literature; and if it is given higher rank the student may, by misfortune,

turn his chief attention to the art of mapping instead of to a study of the things that are mapped.

Physiography and Ontography.—If the principle of explanatory relationship be adopted as a general guide to the content of geography, it follows that neither the inorganic nor the organic elements which enter into geographical relations are by themselves of a completely geographical quality; they gain that quality only when two or more of them are coupled in a relation of cause and effect, at least one element in the chain of causation being inorganic and one organic. When they are considered separately, but as if in preparation for an understanding of the causal relations in which they will be later presented in the study of geography proper, they may be considered sub-geographic; and then the inorganic elements may be called physico-geographic; or physiographic; and the organic elements may be called ontographic. Common usage recognizes the first of these divisions, but not the second, as we shall see later. It is well to emphasize the clause, "as if in preparation for an understanding of the causal relations in which they will later be presented in the study of geography proper;" for many items which, under this proviso, are of physiographic or of ontographic quality, may under another proviso belong in other departments of knowledge.

Physiographic Matters.—This may be made plainer by citing particular cases in which a number of different topics, familiar from their occurrence in books on geography, will be seen to fall under other subjects when they enter into non-geographical relations. For example, the size and rotation of the earth and the general movements of the tides are undoubtedly physiographic elements, yet both may be treated appropriately under astronomy when they are considered in their relations to other planets. Sea-water, when regarded as a liquid compound which holds various salts in solution, may be studied properly by the chemist with regard to its composition; nevertheless sea-water, as the medium in which organic forms live, is an indispensable subject for physiographic inquiry. The horizontal strata of plateaus are a fit topic for geological investigation, as regards their origin and history; but they are no less a subject for physiographic investigation as affecting present form. It, therefore, seems impossible to determine, merely by a consideration of the thing studied, whether it belongs to physiography or not.

A given object may belong under several different sciences, and may be treated in text-books on different subjects; it is the relation into which the object enters that determines its place.

There are, however, certain inorganic topics, commonly found in geo-

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graphical books, which seldom, if ever, enter into relations with organic topics, and which would, therefore, under the strict application of the principle of relationships, be ruled out of physiography, and thus out of geography also. Such are cirrus clouds and haloes, the crevasses and blue veins of glaciers, and the polar flattening of the earth. Nevertheless, most or all of these topics will probably hold their places in books on physiography, because they serve to complete the picture of the whole earth as the home of life. In any case, little is gained by a very strict or over-logical application of a useful principle of classification in a problem such as we are considering.

Ontographic Matters.—The determination of the science under which a thing belongs by means of the relations into which the thing enters is an even more important guide in ontography than in physiography. For example, one may read in a certain text-book of geography that all forms of life consume food. In so far as the assimilation of food and the organs by which it is accomplished are concerned, the consumption of food belongs under physiology; but the consumption of food is an ontographic matter in so far as it brings an organism into contact with the rest of the world and thus causes it to enter into geographical relations.* Commercial geography is largely concerned with relations that grow out of this element of ontography. Water is essential in organic processes of many kinds. This is, again, a physiological matter, if it is examined with reference to the processes of circulation; but it is ontographic when it is found to lead to a relation with the sources of water supply; villages gathered around deep wells on the chalk uplands of northwestern France are examples of the geographic relation thus brought about.

Plants and animals tend to diffuse themselves or to be diffused over the earth. This is a fundamental fact, usually associated with the study of biology; but the limits of diffusion and in many cases the means of diffusion are determined by physiographic controls, hence the tendency to diffusion is an ontographic matter.

The need experienced by all forms of life to secure food, already instanced, leads to many other relations than those of commercial geography. The need of food is satisfied without going in search of it if the food is contained in a moving medium that surrounds the organism; hence those organ-

*As thus defined, ontography is more narrowly limited than in my paper on "A Scheme of Geography" in the Geographical Journal for October, 1903, where it was made practically to include the relations or responses which responding organisms enter into with their inorganic controls. Defined in that way, ontography is too nearly identical with biogeography, or indeed, with geography. As here limited, ontography is not the study of the organic response, which is practically equivalent with the geographical relation itself; it is simply the study of the organic act or deed or motive which results in a response or relation when a physiographic control is encountered.

isms that live chiefly upon food contained in one or the other of the two great mobile envelopes of the earth, the atmosphere or the hydrosphere, are often rooted or fixed: the air or water currents carry the needed food to the waiting plant or animal—and this is surely too important a geographical relation to be omitted from a broad consideration of our subject. Other organisms take advantage of the currents of air or water to be passively carried about by them, taking their food when they happen to come upon it. If they are land-dwellers, they are so small that they can easily be wafted about by the winds; if they are dwellers in water, they may gain greater size by assuming about the same specific gravity as that denser medium, so as to float easily in its perpetual currents*. Still a third class of organisms move of their own volition; and in connection with these there are all manner of geographical relations. Some of them involve the development of wings, whereby motion can be effected in the comparatively unsustaining air, as in the case of many insects and birds, of a few mammals, and formerly of some reptiles; some involve the development of fins to produce motion in the sustaining water. These examples are as good illustrations of organic responses to inorganic controls as are the canoes and the steamships of uncivilized and of civilized man.

It follows from the preceding paragraph that the more closely our standard geographical material is examined, the more clearly it appears that its ontographic as well as its physiographic elements may fall into other sciences when they are treated in other relations; and that they become most distinctly geographic when they enter into the causal relations of the kind set forth above. The rise and fall of the tides is a physiographic matter when it is seen to determine the distribution of certain forms of life, such as barnacles, or to influence the availability of harbors for the entrance of shipping; the occurrence of coal is a physiographic matter when it is found to influence the industry of a district and the commerce between nations; the small size of spores, pollen, and germs is an ontographic matter when it is seen to be related to their transportation by the thin air; the sensitiveness of organisms to temperature changes is an ontographic matter when it is shown to affect the distribution of plants and animals over the earth. Yet all these matters may be treated with entire justice under other sciences than geography. It is, therefore, to my reading, of capital importance in determining whether

*If the substance of this relation were treated under the principle of distribution, it could be presented as follows: Organic forms that have no means of locomotion of their own, but depend on a moving medium for their transportation, are of unlike size, according as they occur on the lands or in the ocean. If they inhabit the lands they are of minute, even of microscopic size, so that they may be carried about by the winds of the unsustaining air; they may be of larger size if they inhabit the ocean, for there they so closely imitate the specific gravity of the water that they float about with its perpetual currents.

a statement is of geographical or sub-geographical nature to know how far it constitutes or enters into causal relations of the kinds that have been here considered.

Is Ontography a Part of Geography?—It is perfectly true that many of the illustrations just given are not commonly regarded as belonging under geography; but it seems to me that their exclusion is illogical and arbitrary. They are practically all to be found in certain standard geographical works, and many more might be taken from such books as Ratzel's Anthropogeographie and Beddard's Zoogeography. The general principle by which one should be guided in determining the relevancy of such matters is as follows: If a certain relation between an inorganic control and a responding organism is a geographic relation, then all similar relations are also geographic. For example, a well-known text-book makes the statement that water-plants are supported by the relatively dense medium in which they grow, and hence do not need strong woody stalks such as many land-plants have. This is an excellent example of a geographical fact: it involves a relation between an organic growth and an inorganic medium.* But the flight of birds, the small size of germs, the essential agreement between the specific gravity of fish and of water, the universal habit of breathing oxygen, all involve similar relations. The first example seems to be undeniably geographic; the others are no less so. To exclude the latter from geography while including the former would be to set very arbitrary limits to our subject.

It may, perhaps, be objected that flight and breathing are processes of too ancient origin to be considered as geographical; but inasmuch as they are maintained into the present time, by inheritance through persistent conditions of environment, they have the same right to a place under geography as is enjoyed by such examples as the prevalence of the fishing industry on the Dalmatian coast, or the custom of the French farmers on the chalk uplands of living in compact villages; for these habits, also, are not independently originated by each man who follows them, but are continued by inheritance through persistent conditions of environment.

There are certain matters, frequently encountered in text-books of physical geography, which belong better, as it seems to me, under ontographic relations. Such are the distribution of plants and animals, and the races of man. The association of such topics with physical geography is probably the result of conceiving all the rest of the subject as contained

*If stated in terms of distribution, this might be phrased as follows: Plants with stems and branches strong enough to support their own weight grow on the land, where the air is too light to buoy them up; plants with weak stems grow mostly in the sea, where they are held up by the heavy water.

under political geography. The contrast of physical with political conditions may serve well enough in elementary books, where the distribution and behavior of man are the chief subjects in political geography, and where plants and animals are therefore thrown in with physical geography; but in the more advanced and general treatment of the subject such an arrangement is not satisfactory. It does, however, seem legitimate to introduce as often as desired ontographic responses in a physiographic text, in order to show at once the kind of response that certain controls call forth, and thus to impress the fact that the physiographic items are really related to ontographic items: a similar introduction of physiographic items is appropriate in chapters on ontography. This practice is followed by certain writers.

There are three definite positions and many indefinite positions that might be taken with respect to the attention that should be given by geographers to organic considerations. The narrowest position limits geography almost entirely to the inorganic features of the earth—that is, to physical geography or physiography. This is the view of geography held by some historians, who take unto themselves practically all the human element that is so commonly encountered in political geography. An intermediate position would include physiography and the more manifest relations into which it enters with various forms of life, and particularly with man, but would not accept responsibility as to the less manifest responses of various living things. This seems to be the position taken by many geographers, more or less consciously. The third position would treat ontography as thoroughly as physiography, and would search for all the geographic relations of physiographic controls and ontographic responses. This is certainly the broadest of the three positions, being, as many would feel, too broad, and involving too much overlapping upon other subjects. For my own part, there seems to be so manifest a necessity of gaining a responsible knowledge of ontography, at least of elementary ontography, before geography proper can be successfully treated, that ontography should come to be regarded as a part of it. The analytical and inductive methods of this paper, therefore, lead me to adopt the third position; and I believe that this position is essentially consistent with the opinion of writers who, like Ratzel and Reclus, have cultivated the most advanced or matured stage of geographical science.

The Importance of Explanatory Relations.—Although various facts which may make parts of relations between inorganic controls and organic responses, or which are met with in preparation for an understanding of such relations, thereby gain a most characteristic geographical flavor, a very brief review of geographical books will suffice to show that many state-

ments there included do not explicitly possess this flavor. In the first place, in the older books the idea of relationship had no distinct recognition. That was the time of memorized names of capes, of empty boundaries, of unexplained lists of products. Almost anything about the earth or its inhabitants was then accepted if it reached a satisfactory degree of what is called "importance." In the newer books, the principle of explanatory relationship is very generally acted upon; there are, nevertheless, many relations stated so empirically that the pupil may fail to gain from them a full appreciation of the best essence of geography. Consider, for example, the following statement from a good text-book: Some form of Celtic is spoken in Wales, the Highlands of Scotland, and western Ireland. This is nothing more than an empirical statement of a fact of distribution. Many a student might memorize such an item without gaining any clear insight into its geographical meaning. The real point is that the early inhabitants of Great Britain being attacked by invaders from the continent on the east, survived only where pursuit was difficult, as in the rough ground of Wales, in the rough and distant ground of the Highlands, or in the distant and isolated ground of Ireland; and hence only there the early language is still preserved. The fact that Celtic, as Celtic, is spoken in certain parts of Great Britain belongs to philology as well as to any other subject; the fact that Celtic is the language that was once spoken generally through Great Britain might come under history as well as under any other subject; but the fact that Celtic is still spoken in rough, distant, or isolated parts of Great Britain, because of their roughness, distance, or isolation, is a local example of an important class of relations between controls and responses, and as such it belongs distinctly under rational geography.

The Expansion of Geography.—Geography has still much progress to make. There is not only much to be done in the way of exploration of little-known lands and seas, but many of the more civilized countries still merit closer study than they have yet received, if we may judge by the notable incompleteness of the best handbooks and treatises. One method of carrying the subject forward consists in outdoor observation; and this method cannot be too highly recommended to those who wish to contribute to the fuller development of our subject. When we realize that we have no modern and maturely-developed account of the geography of such a state as Virginia, or Ohio, or Colorado, or California, it becomes evident that abundant opportunity for exploration lies near at home. But there is a second method by which geography may be promoted—that is, by thinking about what we see, and thus expanding every example of a geographical relation that we find to its farthest legitimate extension. Take, for ex-

ample, the common case of a road which runs through a notch in a high ridge; such a detail of location is a response of the ontographic element, movement, to the physiographic control, gravity; hence all such responses to gravity should be searched out so that they may be systematically treated as to kind, and regionally treated as to distribution. Such matters are surely as properly of a geographical quality as are various responses to sunshine which are always found among the standard matters of our books. How many more responses to the universal and persistent force of gravity there may be, we do not yet know. Again, take such an example as that afforded by the habit of working by day in summer and resting by night in winter. These are responses to the controls of light and heat in contrast to darkness and cold, which result from the illumination and warmth of the rotating and revolving earth by an external sun. This suggests that all other responses to light and to darkness should be sought out and studied; for it leaves the limitations of our subject very vague if we make a beginning with such relations and do not carry them to an end; it makes the limitations very arbitrary if we make a beginning of such relations and stop with the first or the second or the third example, instead of pressing on to the very last.

It is an application of this same principle that makes it impossible to limit the organic side of geography to man; for the habits which man has developed in his search for food, clothing, shelter, and so on are in very many ways closely analogous to those developed by animals in a similar search. In the same way the sensitiveness of man and animals to climatic conditions by which limits of distribution are so largely determined is paralleled by the sensitiveness of plants to similar conditions. Life is a unit; if one form of life comes under the study of geography because it responds to physiographic controls, then all forms of life come under geography.

The expansion of geography through time is likewise inevitable, unless it is most arbitrarily limited to the "present day." Precisely the same principles have been embodied in the relations between physiographic and ontographic elements in the past as are embodied in them now. It is, therefore, most illogical to think of geography as a science that deals only with to-day. There has always been a geography, all through the geological ages; geology is the integration of all its momentary or geographical differentials. We may never know very much about the successive geographies of the past; but all the fragments that have thus far been learned assure us that it was of essentially the same order as the geography of the present. The recognition of this principle is of the greatest importance to geography and to geology as well.

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The Subdivisions of Geography.—It is but natural that the different phases of human geography should have been more fully developed than the other branches of our science. Political geography, frequently overrunning civics, economics and history, has long been familiar as an elementary subject; but with us it has seldom been carried into the higher reaches of education. Commercial geography is rapidly gaining an important place in our schools, and is meeting the danger of becoming almost as empirical as the old-time list of products of the several states. Biogeography has several parts. Anthropogeography, as expanded by Ratzel, seems destined to become an important subject in the universities, because of the greater insight that one gains through it into history. Zoogeography and phytogeography are, in my opinion, as a rule, too strictly limited to facts of distribution alone; these divisions of the subject should be expanded so as to include for animals and plants a consideration of what would correspond to the political and commercial geography of man. Paleogeography is occasionally treated, but it must always be a fragmentary subject, because it is based on fragmentary records; it will, however, be better treated by geologists in proportion as they have had geographical training.

The growth of explanatory treatment, which makes so characteristic a difference between the content of geography in books of a hundred years ago and of to-day, is chiefly due to the different amounts of general knowledge in stock then and now, and consequently to the different philosophies then and now prevailing. The subject has thus gained greatly in strength, in disciplinary value and in living interest. At the same time, geography has come to cultivate more and more—some would say, to trespass more and more—upon the fields that are also cultivated by other subjects. If the trade-winds are not simply described as to region of occurrence, direction of blowing, weather conditions therein prevailing, and so on, but are also explained as parts of an extensive convectional circulation between equator and poles, modified by the deflective effect of the earth's rotation, all this explanatory matter has a strong flavor of physics. If the occurrence of plants of a certain kind in a given region is not merely asserted, but is shown to be the result of climatic conditions to which the plant responds owing to its sensitiveness to temperature and moisture, this closely resembles certain chapters of botany, and the same may be said regarding the relation of animal distribution to zoology. If the boundary of a state, the location of a city, or the industry of a district is rationally explained instead of empirically stated, the explanation is of a kind likely to be found in books on history and economics. Shall we then, in view of this, relinquish explanatory treatment to other subjects and content ourselves with empirical state-

ments? Shall we adopt the limitation to the location of things, as above suggested, and thus avoid duplication with other subjects? No. Duplication is unavoidable; and, moreover, it is reciprocal. The historian, as well as the botanist and the zoologist, must borrow from the geographer all manner of facts regarding location, extent, distribution, climate, form, movements, products, populations, and so on; the geologist can hardly make a step into the realm of the past without having made preparatory study of the present. Overlapping and duplication are unavoidable. We must each of us try as far as possible to concentrate upon his own subject; but we must at the same time borrow and quote with the utmost freedom from any other subject that will give us aid in the consideration of our own.

Examples of Helpful Duplication.—One of the most interesting fields that I have run across in geographical research is that open common where geography and philology overlap. It has often been remarked that the Arabs of the desert have many terms for sand dunes, evidently because they are familiar with the many forms that sand dunes there assume; their language has developed in a peculiar direction as an ontographic response to their peculiar physiographic environment. In the same way, the people of the Alps have various terms by which to name mountain summits of different shapes; this is another ontographic response to a peculiar physiographic environment. But there are other less manifest examples of a somewhat different kind. We treasure as a fine geographic example the long preservation of ancient forms of speech in remarkable purity in Iceland, an out-of-the-way island; and, by way of contrast, we like to mention Malta, an island that is very much in the way, where the mingling of peoples has resulted in the mixture of Arabic and South-European tongues. We have already called attention to the diffusion of organic forms as a fundamental ontographic fact, and we know that variation is an ontographic consequence when diffusion leads to a physiographic environment that involves separation as a result either of distance or of isolation. As examples of this sort of geographic relation, we may point either to the several species of cassowaries on the islands of Australasia; or to the several races of man on the larger divisions of the lands, where barriers formed by the oceans are supplemented by a desert barrier in the Sahara and by a mountain barrier in the Himalaya; or to the several nationalities in Europe, where gulfs and barriers are so important. But why not continue this line of inquiry, and instance, as another example of variation following on diffusion and separation, the differentiation of the Romance languages from Roumania to Portugal, and thus bring in the interesting story of the division of the Langue d'oc and Langue d'oui by the central highlands of France?

XUM

Why not include the even more extraordinary story of the words *pecuniary* and *fee,* which have come to look so unlike on their arrival in our composite language, because of their different paths of travel from their common source? This is of just as good geographical quality as is the contrast between the whites and the blacks in our southern states; they began alike somewhere long ago, and have come to be different through long ages of separation before they are again found together: and separation is an important element of physiographic control.

Not only speech but figures of speech are affected by physiographic environment. There are two examples of far-separated maritime peoples who were so impressed by the manner in which a boat is guided by its rudder that they both came to use a word, which primarily meant a stick and secondarily a stern oar, in a later figurative sense, meaning the guidance or control of a whole people. One of these examples is found with the Scandinavians, where the same word is used in "the helmsman *steers* the boat" and in "the king *steers* the people": here the original and the figurative meanings of the word both survive to-day. The other example began with the people of the eastern Mediterranean, and is now spread through all the Romance languages, and into the Romance element of English. French still preserves the original sense of the word in *gouvernail,* for rudder; but we have lost that sense, unless perhaps in a passage in the Bible concerning the "governor" (helmsman or captain) of a ship, and only know the figurative sense: the word "govern" is therefore a long-lasting response to an early maritime environment. In both these cases it is as legitimate to instance an effect of environment on language as to instance its effect on industry.

THE "CAUSAL NOTION" IN SCHOOL GEOGRAPHY

The emphasis of the causal relations between geographic facts is the keynote to modern school geography teaching and is what distinguishes the so-called "New Geography" from the not wholly to be despised "Old Geography." The causal relations are the permanent phases of geography, for while statistics may change and the features of any one locality vary from year to year, the relations between the people and their environment will be an ever present problem to be worked out. The ability to see causal relations is worth much more to a pupil than information about facts which are not studied causally, for it will make him able to go to new regions and there to study the geography understandingly, and will give him a basis for making items of information contributions to knowledge of permanent value.

ABOUT NETS FOR MAP DRAWING

BY MARK S. W. JEFFERSON,
State Normal College, Ypsilanti, Mich.

SUCH work as Mr. Brown suggests in his admirable paper on map reading (J. G. IV, 273) is so valuable that more and more of it is going to be done and few will do it without wishing they could more readily reproduce maps on varied scales to suit the needs of such work. To-

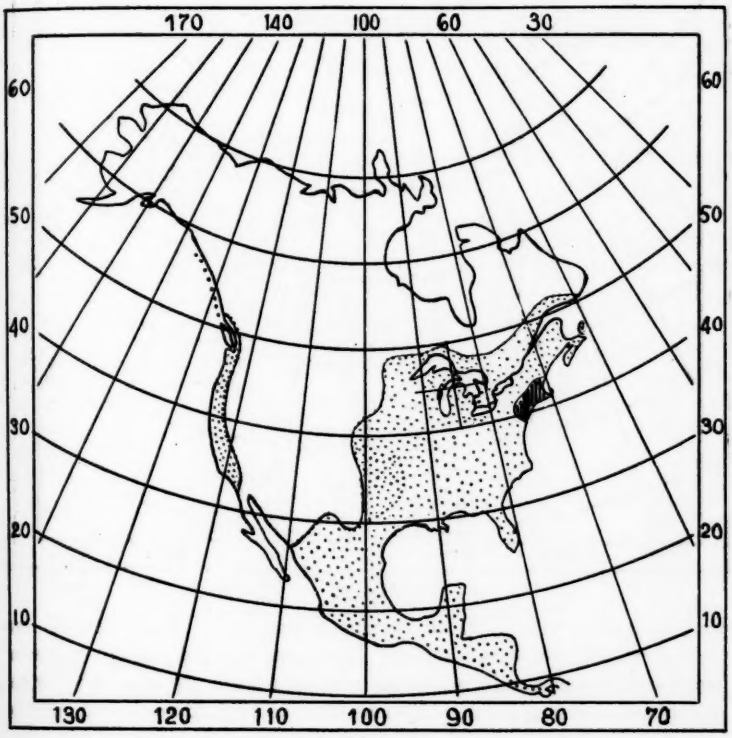


Fig. A.

day the climatic data are best taken from Bartholomew, the populations from Berghaus and various national censuses, the plants from Schimper and other data from numberless other sources. The maps in these books

are on different scales and projections. What we want in our teaching is a consistent series of maps with all the data represented on uniform, comparable diagrams; a large series for the wall and a small one for the class

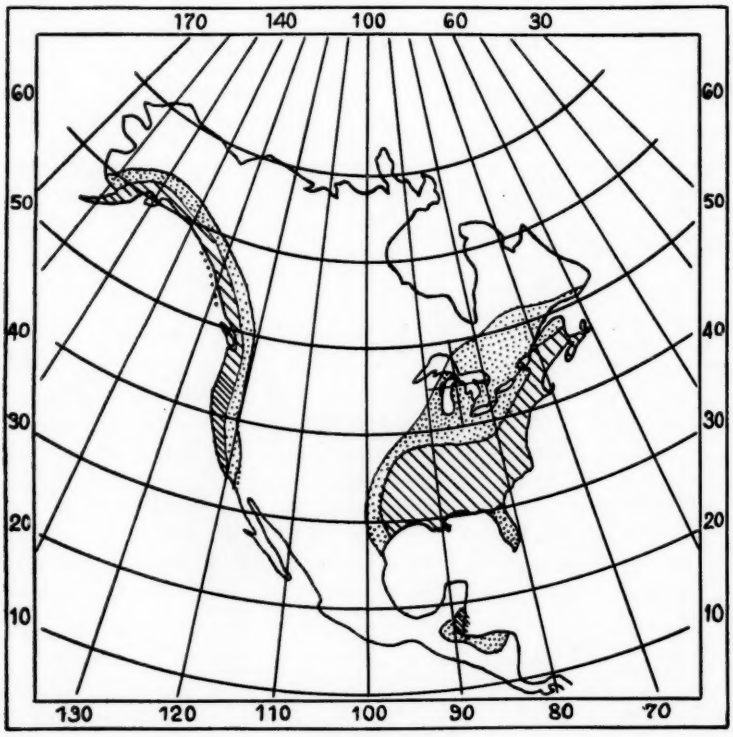


Fig. B.

work on paper. How shall we construct a map, say of North America, on paper measuring 8½ by 5½ inches? We want neat margins but no waste paper and to be able to locate on our map, data from maps that differ from this in size and projection. Believing that many teachers would like to know this, I offer here some simple methods of map making that have withstood the test of continued use in our class rooms.

Here for instance are three maps of North America on the scale of the common, cheap, six-inch globe. A shows the density of population in three degrees of intensity: less than 3 people to a square mile, from 3 to 125, and

over 125. The others show rainfall in three degrees of intensity: less than 6 inches in three months, from 6 to 10 and more than 10; B for December, January and February, and C for June, July and August. No one of the original maps was of this size or scale. To place things in their

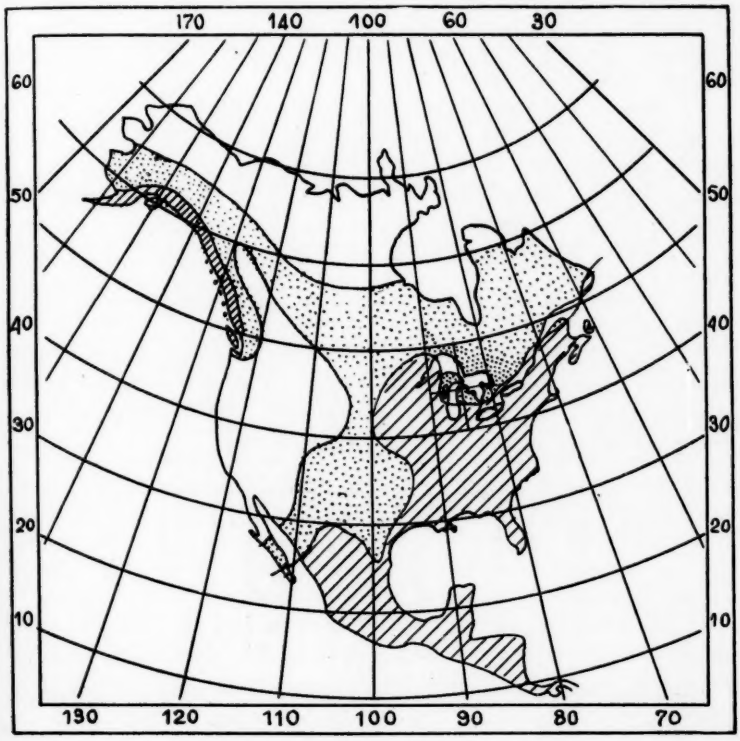


Fig. C.

right places on these maps a network of meridians and parallels is used, because men have found no other practical way of locating things on the nearly spherical earth. Ten-degree meshes are used for convenience in interpolating. This net is very prominent on the maps shown, perhaps too prominent. The drawings were made some years ago and we are drawing the nets somewhat fainter now. But the net idea needs emphasizing. Given the right net you may easily reproduce any map. It is surprising

how good a map the clumsiest pupil will make on a tolerable network and how quickly it can be done. To transfer data from one map to another of different size and projection becomes very simple with this help. But where shall we get the nets? We may make them for ourselves and even little children may make them, for they require the use of straight lines and circles only.

Here is the detail of drawing the net for a map of North America on the scale of the 6-inch globe.

1. Take a sheet of paper at least 5½ inches each way.

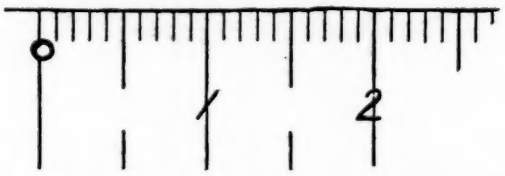
2. Draw a faint line through the middle of the sheet parallel to two edges. Call this line the middle meridian.

3. Put two dots on this line, four inches apart and nearly equidistant from the top and bottom of the line.

4. Draw cross lines 4 inches long through the dots and bisected by them.

5. Connect the ends of the cross lines, making a square bisected by the middle meridian.

6. Outside this square draw another whose sides are separated from its sides by a space two-tenths of an inch wide. This gives the 4-inch square a double frame in which to number our network. We may begin by numbering our middle meridian 100° at top and bottom.



Now we need a rule divided into tenths of an inch and something with which to draw circles. The instrument dealers sell such a rule for ten cents and compasses may be had for all prices from five cents up, but we do not wish to incur expense and some of our circles will have a radius of over nine inches. We may satisfy both needs for barely two cents in this way. Carefully draw with India ink a rule divided into tenths of an inch, numbering only the whole inches. Any engraver will make a zinc etching from this for less than a dollar and from this your printer will make impressions on tough, flexible card. This will serve both as a rule and a compass, especially if you have the printer perforate each rule with a tiny hole placed, as I figure it, on the line of the inner ends of the shorter

divisions on the zero line. With the point of a well sharpened pencil inserted in this hole and a fine needle point thrust through the same point on any other division of the scale, a circle may be drawn of radius equal to the interval between them by fixing the needle in anything and keeping the card taut between the two while the pencil describes an arc. Circles may thus be drawn up to twelve inches radius. Our dealer can supply this rule if you do not wish to make it for yourself.

7. On the 100° meridian, one-tenth of an inch above upper line of the bottom frame place a dot.

8. Place another 5 inches higher on the same line extended.

9. Draw an arc of circle as long as the paper will allow and with 5-inch radius from this last-point (8) as a centre. The needle is pushed through the 5-inch division on the rule just on a line with the upper ends of all the short divisions like the little perforation on the zero line. The point of the needle is now stuck into the dot (8) and the required arc drawn with the pencil point in the perforation. This arc, which is the parallel of 10° north latitude, may be numbered in the frames to right and left. It is drawn right across both frames intentionally. We need it so; but all other parallels and meridians will be drawn only from side to side of the inner square.

10. To draw the other parallels use always the same point (8) as a centre and always insert the needle there, but the needle is to pass through the rule at points each time 0.52 inch nearer the perforation than for the next parallel below. Thus for 20°, the radius will be 5.0″—0.52″ or 4.48″ and the interval is taken a little less than 4.5″. For 30°, 3.96″ is used, and so on. Draw the parallels up to 80° in this way, ending each at the inside line of the frame and number at both ends.

11. To draw the meridians lay off on the 10° parallel equal spaces of 0.56 inches to right and left from the 100° meridian out to the edge of the paper. Take the needle from the rule, stick it into the centre point (8) and placing the rule from this to the divisions just made on the 10° parallel, one by one, draw the meridians or the parts of them that fall within the inner frame. Now number the meridians and the net is ready for the map. As it very closely resembles the net on a six-inch globe in shape and size the map drawn on it will resemble that drawn on the globe very closely. The actual drawing of the map from any larger copy is very simple, working mesh by mesh. With a little practice it may be done very accurately.

Three of our measurements were essential.

The outer radius (to 10° N.).....5.00
The 10° latitude difference.....0.52
The 10° longitude difference on 10° N.....0.56

XUM

These may be called the elements of the net and on them the accuracy of our work depends. The frame is of course not necessary, but adds to the neatness of the work, and in selecting a scale to work on that will suit our needs it is very convenient. Suppose for instance we are to use a sheet measuring 8 by 10 inches. Leaving an inch on each side for outer frame and margin we have a 6-inch square for our net. As this is half as long again on each edge as the one for which the elements are given, we shall use elements each enlarged in the same proportion; that is 7.50″, 0.78″ and 0.84″.

ELEMENTS FOR CONTINENT MAPS, SCALE OF THE 6-INCH GLOBE

	Radius	Parallel	10° long.	10° lat.	Frame
North America	5.0063	10° N.	.5616	.5176	4 by 4
Europe	3.3879	30° N.	.4844	.5221	3 by 3
Asia	5.0063	10° N.	.5616	.5176	5 by 5
Australia	7.4328	10° S.	.5276	.5226	3.5 by 3
South America	9.0733	10° N.	.5675	.5159	3.5 by 4.5
Africa	∞		.5236	.4994	4.2 by 4.2

To illustrate suppose we wish to make a net for Australia on the scale of the six-inch globe that we use for a standard. Shortening the description, which may be made out by referring to the previous one, the steps are:—

1. Paper at least 5″ by 9″.
2. Middle meridian the long way of the paper.
3. Dots 3″ apart, upper one 0.5″ from top of paper.
4. Cross lines 3.5″ long.
5. Rectangle 3 by 3.5″.
6. Outer rectangle 0.2″ outside.
7. Dot 0.2″ *below lower* line of *upper* frame.
8. Another dot 7.43″ lower for centre of circles.
9. Parallel of 10° S. from this centre with radius 7.43″.
10. Radii successively 0.52″ smaller, same centre.
11. Meridians distant 0.53″ on 10° S.

Compare diagram D reduced to half size of standard.

This time the meridians converge downwards as they should for a southern continent. Any of these nets may be made of any desired size by multiplying the elements by the appropriate number. The earth is about forty-two million feet, the six-inch globe half a foot in diameter, so its scale may be said to be one eighty-four millionth of nature. To draw a map of Europe, for instance, on some other scale, as one ten-millionth, we have only

to multiply the elements given in the table by $\frac{84}{10}$ or 8.4, giving 28.45″ longitude 4.07″, latitude 4.38″ and the frame 25″ square.

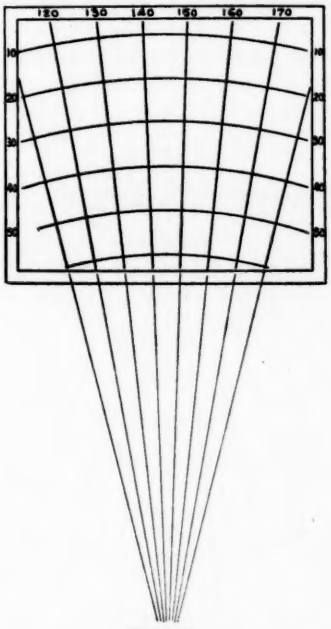


Fig. D.

Or suppose we wish to draw a map of Europe on which an inch shall represent a thousand miles for convenience in measuring distances. Our six-inch globe represents an earth 7912 miles in diameter. Each inch therefore stands for $\frac{7912}{6}$ miles, 1319 nearly. The required globe is larger in the proportion of 1319 to 1000. All lines on it therefore are 1.32 times longer than on the six-inch globe. Its diameter is 7.92″, the elements of the required nets R=4.47″, long.=0.64″, lat.=0.69″. On such a map the rule divided to tenths of an inch makes measurements very simple. Similarly a multiplier 13.19 would give a net with a scale of 100 miles to the inch, a neat wall map 40 inches square.

For Africa the sign of infinity in the radius column suggests that the parallels are, for this continent, represented by straight lines and the meridians do not converge. The net thus becomes a rectangle divided into smaller rectangles, each measuring 0.50″ by 0.52″.

XUM

Asia extends further south of the 10° parallel than North America, so we put the dot in (7) nine-tenths of an inch above the upper line of the bottom frame. Another parallel—the equator—may also be added outside the 10° parallel.

To Find the Value of the Elements.—The reader has perceived that the nets we are using are conic projections. That is, the paper on which we

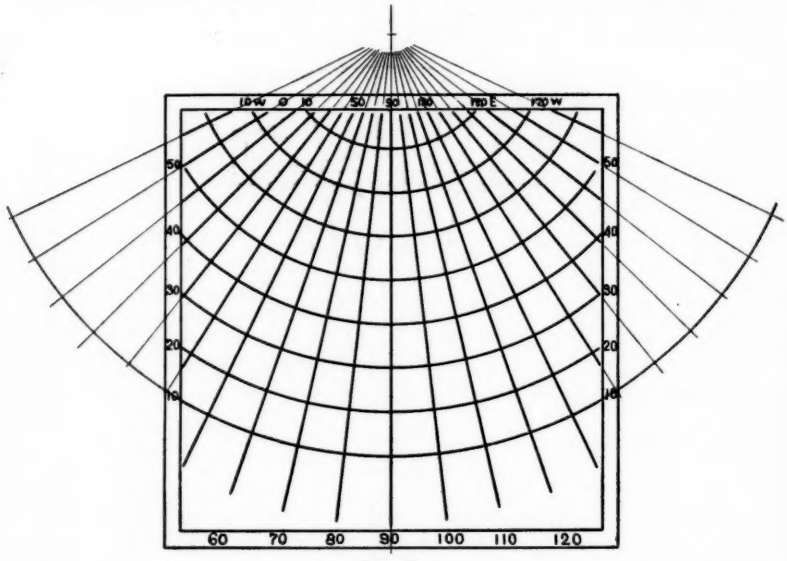
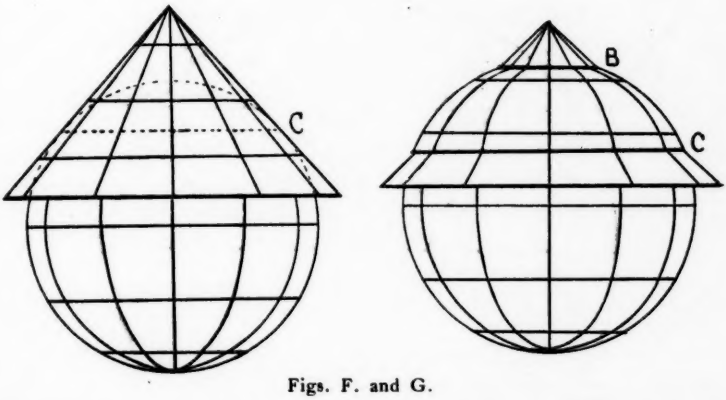


Fig. E.

have drawn our nets may be rolled so as to become part of a cone. A cone is very simply made of paper by cutting a sector from a circle and rolling the remainder so that the gap is closed up and the cut edges come together. For the common tin funnel of the kitchen a circle is cut in two on a diameter and each half rolled till the two halves of the straight edge on each come together. This makes two cones from each circle of tin and wastes no metal. For any belt of moderate width about the earth, some cone can be constructed that has a belt that can be put almost in coincidence with it. A very accurate drawing may be made on such a cone and the nature of the surface allows us to unroll it and lay it out flat as our books and maps must be laid and as we can never lay out any part of the surface of a sphere. The cone used may be either *tangent* as in Fig. F. where the two surfaces coincide only on the parallel passing through C, or *secant,* as in Fig. G where

they intersect on the two circles through B and C. It is evident that in the latter case the two surfaces come nearer coincidence. This is the cone on which our nets are drawn, as more accurate when considerable parts of the earth's surface are to be represented.

Let us consider the cone for drawing Europe. Europe lies mostly between the parallels of 40° and 70° north latitude. That gives it an extent of 30° of latitude. Fig. H. is a meridian section of a six-inch globe with Europe reaching from K to H. Divide the distance HK (=30°)* into



Figs. F. and G.

quarters (=7½°) and locate B and C 7½° from H and K respectively. The arc BC is of 15° and so is the sum of the arcs HB and CK. ADD' is a cone so constructed as to cut the globe in the parallels through B and C. Through half of the latitude of Europe (BC=15°) the surface of the globe is outside of the surface of the cone, but through the two quarters making up the other half (HB and CK) it is below. To find just where B and C should be placed on the circle, draw the equator and the polar axis at right angles to each other and lay off 47½° and 62½° from E with a protractor, these points being respectively 7½° within 70° and 40°. We use a protractor of transparent paper, marking the points through with a needle point. The parallels through B and C are common to both cone and globe. On both they are the parallels of 47½° and 62½°. On both they are 15° of latitude apart. If we lay our rule on the straight line BC and measure it we shall find 15° of latitude on the cone. Two-thirds of this will be the *latitude difference* required as one of our elements. As a

*Here reduced one-half in size.

number of points of Europe lie to the south of the parallel of 40° we will find where the 30° parallel comes on the cone.*

The required point will be 17½° (47½°—30°) from C. We have

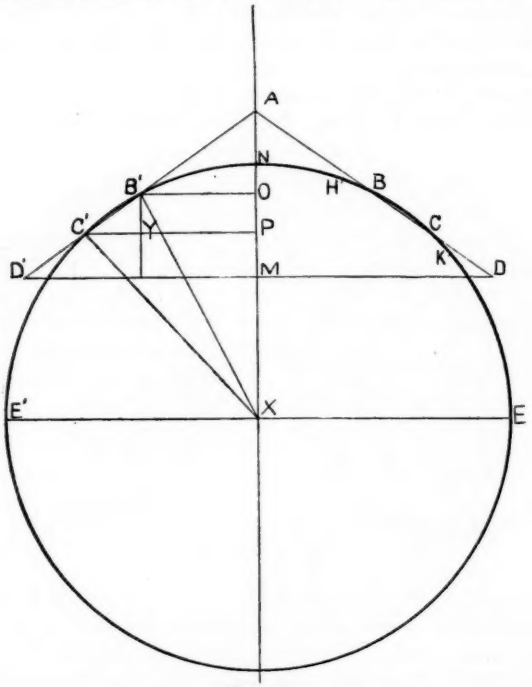


Fig. H.

just measured BC which represents 15°. Let us take $\frac{17\frac{1}{2}}{15}$ of BC from C outward and call the point D. If we now measure the line AD with the rule we learn another element, the *Radius to the parallel of* 30°, every point in that circle being that distance away from A. The remaining element is 10° longitude on the parallel through D or $\frac{1}{36}$ of the whole circumference of that circle. DM, the radius of the circle, must be measured. 2π DM will be the circumference and $\frac{2\pi DM}{36}$ is the required 10° or 0.1745 DM.

The construction has these parts:—

1. Construct a six-inch circle with two diameters at right angles.
2. Find the northern and southern latitude of your continent, its extent

*It may seem as if it could be found by laying off 30° from E with the protractor but this gives only the corresponding point on the globe.

in latitude, divide this by 4 and determine points ¼ of this latitude extent from the extreme latitudes.

3. Locate these points on the arc with a protractor.

4. Draw a line through these two points to the polar axis.

5. Measure BC and from it learn the *Latitude Difference* by taking the proper proportion.

6. Locate a suitable outer parallel (D) by measuring from C.

7. Measure AD for the *Outer Radius.*

8. Let fall DM perpendicular to the polar axis, measure DM and multiply by 0.1745 ($=\frac{2\pi}{36}$) to get the *Longitude Difference.*

This construction gives accurate enough values for our purpose if care be used. The values in the table have been determined more closely by a calculation with simple trigonometrical ratios. This is now given with reference to the left side of diagram H.

Regarding the circle as of unit radius, OX and OB′ are the sine and cosine respectively of the angle E′XB′ ($=62\frac{1}{2}°$), and PX and PC′ are the sine and cosine of E′XC′ ($=47\frac{1}{2}°$). Then in the triangle B′YC′,

B′Y=OP=sin 62° 30′—sin 47° 30′ and

C′Y=cos 47° 30′—cos 62° 30′.

$B'C'=\sqrt{B'Y^2+C'Y^2}$ and from the similarity of the triangles B′C′Y and AC′P

$AC'=\frac{B'C' \times C'P}{C'Y}$

AD′ as before=$AC'+\frac{17\frac{1}{2}}{15}$ B′C′ and in the similar triangles AD′M and B′C′Y $D'M=\frac{AD' \times C'Y}{B'C'}$

10° longitude on 30° north=$\frac{2}{36}\frac{\pi}{D'M}$=0.1745 D′M.

10° latitude $=\frac{8}{3}$ (BC)

Each of the elements should now be multiplied by three to change them from the unit globe of the calculation to the six-inch globe required (3″ radius). The calculation for Europe is added to show the arrangement of the work for logarithms.

EUROPE, sections at 47½° and 62½°, D at 30° north latitude.

C′Y=PC′—PY=cos 47½°—cos 62½°

B′Y=OX—PX=sin 62½°—sin 47½°

$B'C'=\sqrt{B'Y^2+C'Y^2}$, $AC'=B'C' \times \frac{C'P}{C'Y}$, $D'M=\frac{AD' \times C'Y}{B'C'}$

cos 47½°	[9.8296833]	0.675590	(1)
cos 62½	[9.6644056]	0.461749	(2)
sin 62½	[9.9479289]	0.887011	(3)
sin 47½	[9.8676309]	0.737277	(4)
C′Y	[9.3300909]	0.213841	(5)=(1)—(2)
B′Y	[9.1753204]	0.149734	(6)=(3)—(4)

XUM

$\overline{C'Y^2}$	[8.6601818]	0.045728	(7)=(5)²
$\overline{B'Y^2}$	[8.3506408]	0.022420	(8)=(6)²
$\overline{B'C'^2}$	[8.8334531]	0.068148	(9)=(7)+(8)
B′C′	[9.4167265]	0.261052	(10)=$\sqrt{(9)}$
$\frac{1}{C'Y}$	[0.6699091]	.....	(11)=$\frac{1}{(5)}$
AC′	[9.9163189]	0.824743	(12)=[(1)]+[(10)]+[(11)]
17½	[1.2430380]	17.5	(13)
$\frac{1}{15}$	[8.8239087]	.....	(14)
$\frac{17\frac{1}{2}}{15}$ × B′C′	[9.4836732]	0.304560	(15)=[(10)]+[(13)]+[(14)]
AD′	[0.0528104]	1.129303	(16)=(12)+(15)
$\frac{1}{B'C'}$	[0.5832725]	.....	(17)=$\frac{1}{(10)}$
D′M	[9.9661748]	0.925070	(18)=[(17)]+[(16)]+[(5)]
2	[0.3010300]	2.	(19)
π	[0.4971503]	3.141596	(20)
$\frac{[1}{36}$	[8.4436975]	.....	(21)
10° on lat. 30°	[9.2080526]	0.161455	(22)=[(18)]+[(19)]+[(20)]+[(21)]
⅔	[9.8239083]	0.666666	(23)
⅔ B′C′	[9.2406348]	0.174034	(24)=[(23)]+[(10)]

Multiplying each element by 3, the radius of a six inch globe, we have:—

(16) AD =3″.387909
(22) 10° l. Lat. 30°=0.484365
(24) 10°Lat. =0.522102

The cone for Africa is to be regarded as of infinite altitude which makes it a cylinder cutting the globe in 17° 30′ north and south latitude. The geometrical construction offers no difficulty while the computation takes the form:—

$\frac{2\pi \cos 17° 30'}{36}$ for 10° longitude

and $\frac{2 \sin 17° 30'}{3.5}$ for 10° latitude, we divide by 3.5 since the distance between the points B and C this time is 35°, three and a half times as great as the interval of latitude wanted.

Tangent Cones.—In some cases, for countries of little extent in latitude, a simpler net may be used. The six-inch globe being too small for single country maps a scale of $\frac{1}{10,000,000}$ is adopted and a mesh of 2°, except for Switzerland and Michigan where 1° is used and for other small countries. This scale corresponds to a globe 50 inches in diameter.

To draw a net for Great Britain and Ireland.

1. Take paper at least 5½ inches square, and pin it down on one end of a strip of manilla paper 5½ by 24 inches.

2. Draw a middle meridian the long way of the two sheets.

3. Put two dots on the white paper, on the meridian, 5½ inches apart and about equally distant from the ends of the paper.

4. Draw 4-inch cross lines through the dots and finish the rectangle 4 by 5½.

5. Draw another rectangle outside this for the outer frame.

6. On the middle meridian (4° W.) put a dot 2 inches up from the top line of the bottom frame.

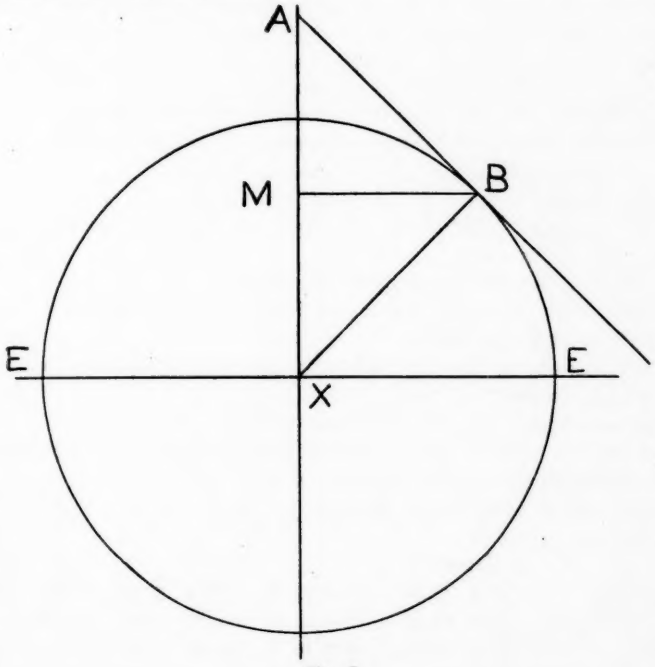


Fig. J.

7. Put a dot on the manilla paper 18.22 inches from this (6).

8. With this last as a centre draw the parallel of 54°, using 18.22 inches for radius and continuing arc all across the paper. Two rules pinned together give the requisite length.

9. Other parallels from 50° to 60° may be drawn using a latitude difference of 0.875″.

10. Points are placed on the 54° parallel for meridians by using a 2° longitude difference on 54° of 0.514″.

11. Draw meridians within frame and number.

The Parallel of 54° *was the Tangent Parallel.*—The values of the elements are found much as in the case of the secant cone. Suppose Fig. J to be a circle 5 inches in diameter with equator and polar axis and on one side of a tangent cone represented by AB. B is located by protractor near the proper middle latitude of the country. We did not use 55° for Great Britain because we were drawing only even numbered parallels and 54° which we were to draw is near enough to the middle British latitude. AB is taken from the diagram by direct measurement and is the radius. MB is measured and multiplied by $\frac{2\pi}{180}$ (=0.03491) to get 2° of longitude on 54°, while BX multiplied by the same quantity gives us 2° of latitude. But the circle we have measured was only 5 inches in diameter. To get elements for the 50-inch globe we must multiply the elements thus obtained by 10. The precise values are computed as follows:—

R=25.0687″=radius of the globe on the given scale.

2° latitude= $\frac{2\pi \times 25.0687}{180}$ =0.03491×25.0687=0.8751 for all countries alike on this scale.

AB=radius to tangent parallel=R cot BXE,

BXE being the middle latitude of the country to be drawn.

AB=25.0687 cot BXE.

2° longitude at B= $\frac{2\pi}{180}$ MB=0.03491 MB=0.03491 R cos BXE =0.03491×25.0687 cos BXE,

values more easily computed than those of the secant cone.

A table is herewith given of the elements computed for some of the more important countries in these two ways.

Elements of conic Projections, Scale $\frac{1}{10,000,000}$

	Extent		Radius	2° l	2° lat	Divided parallel
Intersecting Cones:						
Argentine	74 to 57 W	56 to 22 S	38.03	0.836	0.872	22 S
Brazil	34 to 74 W	4 N to 34 S	100.86	0.908	0.873	4° N
Chile	66 to 76 W	56 to 16 S	38.03	0.836	0.872	22 S
China	97 to 123 E	42 to 18 N	48.46	0.846	0.873	18 N
India	66 to 101 E	38 to 6 N	67.20	0.897	0.872	6 N
Mexico	89 to 115 W	15 to 33 N	60.63	0.858	0.876	14 N
Scandinavia	4 to 30 E	72 to 54 N	17.09	0.670	0.870	53 N
Tangent Cones:						
France	8 E to 6 W	42 to 52 N	24.21	0.608	0.875	38 N
Germany	4 to 24 E	46 to 56 N	19.58	0.539	0.875	52 N
Great Britain	2 E to 10 W	50 to 60 N	18.22	0.514	0.875	54 N
Italy	6 E to 20 E	36 to 47 N	27.84	0.650	0.875	42 N

Japan	128 to 146 E	46 to 30 N	32.09	0.689	0.875	38 N
Spain	4 E to 10 W	36 to 44 N	29.87	0.670	0.875	40 N
One degree meshes						
Michigan	82.5 to 90.5° W	41.5 to 48.5 N	25.07	0.310	0.438	45 N
Switzerland	6 to 11 E	44 to 48 N	23.38	0.298	0.438	47 N

If a habit be made of much map drawing it will often be desired to give the class ready-made nets. A net may be made for this purpose to embrace rather more than the area of one continent and on this any land or any

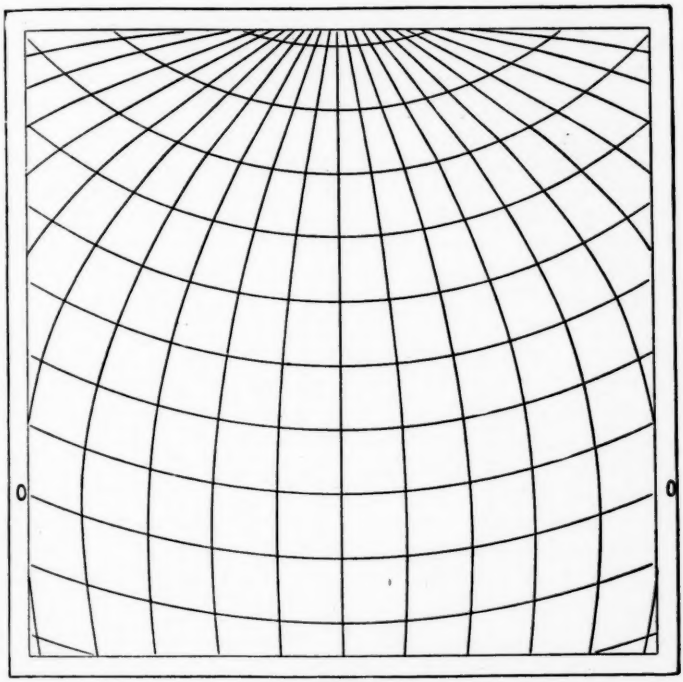


Fig. K.

ocean may be placed. Fig. K is such a universal net reduced from one of those used with our Ypsilanti classes on the scale of the 9-inch globe. To prevent the distortion inevitable in the outer parts of conic nets when they are of great extent, the meridians have been drawn as curves, giving the longitude space on each parallel the same value it has on the corresponding globe.

THE MIGRATION OF BIRDS AS A SUBJECT FOR GEOGRAPHY STUDY

BY SPENCER TROTTER
Swarthmore College, Pa.

THE migratory movement of birds has a geographical as well as an ornithological point of view. To most persons and to ornithologists especially, the interest in this phenomenon must largely lie in the remarkable instinct that impels the bird to travel thousands of miles by land and sea, and in the no less remarkable power of orientation—the guiding sense—that leads the bird from one locality to another over long distances, and this too, in the great majority of cases, in the darkness of night. There is also much that might be learned in the way of geography from the study of bird migration; and it is the purpose of this paper to set forth some of the facts which have been gathered of late years as to the routes taken by migratory birds and the geographical features which influence and condition the movement.

It has seemed to me that there is much good matter in the subject of bird migration that might well be presented to a class in geography study. There is an element of mystery and adventure about the migrating bird that lends a certain interest and color to the bare geographical facts. Let me illustrate by an example. A number of years ago, when I used to shoot bay snipe on the south shore of Long Island, there was always the possibility of falling in with one of those remarkable flights of the golden plover that occasionally happened sometime during the month of August. These flights or 'waves' would suddenly appear in the neighborhood of Montauk Point, spread along the shore and as suddenly vanish, appearing nowhere again along the entire Atlantic border of the United States. Where did these plover flocks come from and whither did they go? It was not until the past few years that the question was solved, and even yet many of the features of this great migratory flight are wrapped in mystery. Mr. Wells W. Cooke of the Biological Survey in a reprint from the Department of Agriculture's Year Book for 1903 entitled "Some New Facts About the Migration of Birds" has given, among other interesting matter, an account of what is now known about this remarkable plover migration. I cannot do better than quote Mr. Cooke's own words.

"As already stated, the longest migration route is taken by some of the wading birds, especially the American golden plover, the Eskimo curlew, and the turnstone. The journey of the plover, which is typical, is won-

derful enough to be given in detail. In the first week of June they arrive at their breeding grounds in the bleak, wind-swept 'barren grounds' above the Arctic Circle, far beyond the tree line. Some even venture 1,000 miles farther north (Greely found them at latitude 81°). While the lakes are still icebound, they hurriedly fashion shabby little nests in the moss only a few inches above the frozen ground. By August they have hastened to Labrador, where, in company with curlews and turnstones, they enjoy a feast. Growing over the rocks and treeless slopes of this inhospitable coast is a kind of heather, the crowberry, bearing in profusion a juicy black fruit. The extravagant fondness shown for the berry by the birds, among which the curlew, owing to its greater numbers, is most conspicuous, causes it to be known by the natives as the 'curlew berry.' The whole body of the curlew becomes so saturated with the dark purple juice that birds whose flesh was still stained with the color have been shot one thousand miles south of Labrador.

"After a few weeks of such feasting, the plovers become excessively fat and ready for their great flight. They have reared their young under the midnight sun, and now they seek the Southern Hemisphere. After gaining the coast of Nova Scotia they strike straight out to sea, and take a direct course for the easternmost islands of the West Indies. Eighteen hundred miles of ocean waste lie between the last land of Nova Scotia and the first of the Antilles, and yet six hundred more to the eastern mainland of South America, their objective point. The only land along the route is the Bermuda Islands, eight hundred miles from Nova Scotia. In fair weather the birds fly past the Bermudas without stopping; indeed, they are often seen by vessels four hundred miles or more east of these islands. When they sight the first land of the Antilles the flocks often do not pause, but keep on to the larger islands and sometimes even to the mainland of South America. Sometimes a storm drives them off the main track, when they seek the nearest land, appearing not infrequently at Cape Cod and Long Island.

"A few short stops may be made in the main flight, for the plover swims lightly and easily and has been seen resting on the surface of the ocean; and shore birds have been found busily feeding five hundred miles south of Bermuda and one thousand miles east of Florida, in the Atlantic, in that area known as the Sargasso Sea, where thousands of square miles of seaweed teem with marine life.

"Though feathered balls of fat when they leave Labrador and still plump when they pass the Bermudas, the plovers alight lean and hungry in the Antilles. Only the first, though the hardest, half of the journey is over.

How many days it has occupied may never be known. Most migrants either fly at night and rest in the day or vice versa, but the plover flies both night and day.

"After a short stop of three or four weeks in the Antilles and on the northeastern coast of South America, the flocks disappear, and later their arrival is noted at the same time in Southern Brazil and the whole prairie region of Argentina almost to Patagonia. Here they remain from September to March (the summer of the Southern Hemisphere), free from the responsibilities of the northern summer they have left. The native birds of Argentina are at the time engrossed in family cares; but no wayfarer from the north nests in the south.

"After a six months' vacation the plovers resume the serious affairs of life and start back toward the Arctic, but not by the same course. Their full northward route is a problem still unsolved. They disappear from Argentina and shun the whole Atlantic coast from Brazil to Labrador. In March they appear in Guatemala and Texas; April finds their long lines trailing across the prairies of the Mississippi Valley; the first week of May sees them crossing our northern boundary; and by the first week in June they reappear at their breeding grounds in the frozen north. What a journey! Eight thousand miles of latitude separates the extremes of their elliptical course, and three thousand miles of longitude constitutes the shorter diameter, and all for the sake of spending ten weeks on an Arctic coast."

How can all this interesting matter about the plover be applied in a course of geography class work? In the first place the breeding range of the bird—the "barren grounds" of Arctic America—is to be considered; its climate, prevailing winds, and other physical features, and its life; reason for the name "barren grounds"; the Arctic day, the short summer, and the midnight sun; the abundance of food, character of the vegetation, and the insect life; why the birds leave early, and other interesting questions. The coast of Labrador, its features, fisheries and people. Nova Scotia, its geographical position and features. Under the head of the ocean route the Western Atlantic should be studied—absence of any large islands noted; nearest land to the line of flight; prevailing winds, the storm tracks and the fog bank, and why the birds occasionally appear on Cape Cod and Long Island. The position of the Bermudas and the physical features of these islets. The Sargasso Sea—its extent and characteristics (its historic reference in the voyage of Columbus). The Antilles in like manner would claim attention. Then the continent of South America—its physical features and configuration as a whole; the great rivers and the tropical forest

region (the selvas of the Amazon); the pampas region of Argentina—its climate and life features. Lastly, the Mississippi Valley as the path of the return migration in the spring; the prairie country and its food supply; the physical features of the central United States and of Canada.

Here is an array of the most interesting and varied geographical matter made vivid and personal by the migratory flight of this remarkable bird. Nor is the plover alone remarkable. The path of every migrating bird holds a lesson in geography. One is led by the survey of such facts into wider fields of thought and observation. Geography thus becomes linked with nature study in one of its most attractive aspects.

The bobolink affords another interesting example. Well known in rural New England and throughout the northern country generally as a bird of spring and early summer, conspicuous alike for its striking color pattern and its voluble medley of song, it is equally famous for its long migratory journey. It passes south in large flocks during the early autumn and is known by the inhabitants of the Middle Atlantic States as the reed bird—from its habit of frequenting the river marshes where it gorges itself on the wild oats until its fat body becomes a toothsome dainty, eagerly sought for by the epicure. In the Carolinas and along the Southern Coastal Plain it is known as the rice bird. Arriving on the Florida coast these flocks launch forth over the waters of the Mexican Gulf to Cuba, a distance of one hundred and fifty miles. From Cuba they pass on to Jamaica, a stretch of ninety miles, and then begins their great voyage across the Caribbean Sea, five hundred miles to the mainland of northern South America, with no rock or islet as a stopping place. "Indeed," as Mr. Cooke remarks, "many bobolinks appear to scorn the Jamaican resting point and to compass in a single flight the seven hundred miles from Cuba to South America. With the bobolink is an incongruous company of traveling companions—a vireo, a kingbird, and a nighthawk that summer in Florida; the queer chuck-will's-widow of the Gulf States; the two New England cuckoos; the trim Alice thrush from Quebec; the cosmopolitan bank swallow from frozen Labrador, and the black-poll warbler from far-off Alaska. But the bobolinks so far outnumber all the rest of the motley crew that the passage across the Caribbean Sea from Cuba to South America may with propriety be called the 'bobolink route.' Occasionally a mellow-voiced wood thrush joins the assemblage, or a green-gold tanager which will prepare in the winter home its next summer livery of flaming scarlet. But the 'bobolink route' as a whole is not popular with other birds, and the many that traverse it are but a fraction of the thousands of North American birds that spend the winter holiday in South America."

XUM

The main route of migration appears to be along the western shores of the Mexican Gulf and from Cuba to Yucatan, and for a very obvious reason—a continuous land mass and an abundant food supply.

The Eastern Hemisphere affords similarly much interesting matter relating to bird migration. Many of the migratory birds of Western Europe spend the winter in Northern Africa and Palestine. The Sahara offers an impassable barrier to their further southward range. Here is an interesting point for comparison with the Western Hemisphere where no such desert zone exists. It has long been observed that migrating birds cross the Mediterranean at three points only—(1) at Gibraltar, (2) by way of Sicily and Malta, and (3) through the Grecian isles and Cyprus. These three routes correspond to the three ancient land bridges that once connected Europe with Northern Africa, but which have since been submerged, forming ridges now covered by comparatively shallow depths of sea.

Such a well known bird as the nightingale has been cited by Wallace as a typical migrant. The nightingale winters in the Jordan Valley, throughout the region of Asia Minor in general, and in Northern Africa. "Early in April it passes into Europe by the three routes already mentioned and spreads over France, Britain, Denmark, and the south of Sweden, which it reaches by the beginning of May. It does not enter Brittany, the Channel Islands, or the western part of England, never visiting Wales, except the extreme south of Glamorganshire, and rarely extending farther north than Yorkshire. It spreads over Central Europe, through Austria and Hungary to Southern Russia and warmer parts of Siberia, but it nevertheless breeds in the Jordan Valley, so that in some places it is only the surplus population that migrates. In August and September all who can return to their winter quarters." (See Wallace—"Geographical Distribution of Animals" (Vol. I., p. 21).

This, I think, would make remarkably attractive matter for a class in geography when studying the old world. The nightingale is one of the birds that has a strong human interest. It has been immortalized in English poetry, and it is interesting to note in this connection that Keats in his "Ode to a Nightingale" makes allusion to the bird's distribution in Palestine:

> "Perhaps the self-same song that found a path
> Through the sad heart of Ruth, when sick for home,
> She stood in tears amid the alien corn;"

The teacher who may become interested in this subject should obtain from the Biological Survey of the Department of Agriculture at Washington the various reprints relating to migration, particularly the aforemen-

tioned paper by Mr. Cooke and also his work on "Warbler Migration." These, if in print, may be had without cost on application. Other books which the teacher should have access to are Chapman's "Handbook of the Birds of Eastern North America" and Mrs. Bailey's "Handbook of the Birds of Western North America" for identification of different birds and for information regarding their habits, distribution, and so forth. Any good library should be able to supply books dealing with the various countries under consideration. It is needless to refer to Poole's Index as a guide to current periodical literature where much valuable information may be obtained. The organizing of such material for class work must lie mainly in the hands of the teacher. Each one will have his or her individual way of taking hold of the subject. A number of good wall maps are essential for tracing out the routes of migrating birds before a class, and outline maps might be used in the same way by pupils. A good picture or a specimen of the bird under consideration would be a very happy feature of the work. Reading about the bird in class by the teacher or the pupils would of course be to the point, and the pupils should be questioned as to whether any one knows the bird and can tell anything about it. Some boys and girls are surprisingly well informed about birds.

There is no claim that this study of bird migration is to replace in any way the regular class-room work in geography. It is merely in the hope of supplementing the more formal and necessary routine, along the line of a new interest, that I have been tempted to present this attractive subject to readers of the JOURNAL.

THE CENTURY PLANT IN MEXICO

The maguey, or century plant, is native to the highlands of Central Mexico, ranging from 6,000 to 7,000 feet altitude. At present the plants are grown on large plantations, or haciendas, thousands of acres being devoted to its cultivation. From it the Mexican Indian obtains the native beverage, *pulque,* and a fiber that, as Mexican fiber, is used for making rope, cordage, bagging, matting, thread, clothing, hammocks and other coarse textile stuffs.—*Bulletin, Geographical Society of Philadelphia,* April, 1906.

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EDITORIALS

THE SAN FRANCISCO MEETING OF THE NATIONAL EDUCATIONAL ASSOCIATION

THE National Educational Association will hold its annual meeting this year in San Francisco, Cal., from July 7 to July 14. A special rate of one fare, plus two dollars for membership in the Association, is offered for the round trip with practically unlimited stop-over privileges west of Missouri River points. Tickets will be good from Chicago from June 25 to July 6 and from New York from June 24, with return privilege to September 15.

In addition to these unusually favorable rates special excursions will be offered about California at rates of one and one-third fare for round trip.

This is an opportunity to see the United States rarely offered and should be seized by all teachers, and especially by all teachers of geography, who can possibly make arrangements to do so.

The trip across the continent is in itself an education to all who do not know the wonders of the Great West and any teacher, however uninterested in geography, will gain experiences of great value in her class-room work if she will but look at the scenery as she rides rapidly through the country. These experiences will be greater and richer if one route is followed in one direction and another in the other direction.

The Pacific States are full of scenic features that should be seen leisurely and as thoroughly as possible. The view even of San Francisco and its wonderfully beautiful harbor is in itself not the least of the scenic beauties of this far famed region.

Any who contemplate taking the trip should secure from the Secretary of the Association, Mr. Irwin Shepard, Winona, Minn., a copy of the preliminary announcement of routes and probable cost of the trip. Inquiry of any agents of the great transcontinental railroads will bring full and prompt answer to any detailed questions. Such inquiries should be made at once so that time may be taken to plan one's itinerary slowly and carefully. Many personally conducted excursions will also be run from the larger cities of the country, details of which may be secured from the State representatives of the National Educational Association.

The supposed object of the excursion is to attend the meetings to be held in San Francisco but more geography will be learned from the trip than from the meetings, though geography teaching will have a place on the program, as will be announced in detail later.

The trip in itself is an investment which will repay all who want to see new country, meet new people, come in contact with the spirit of a new region and be refreshed by getting away from the hackneyed surroundings of everyday life in even the most favored localities.

It is to be hoped that teachers will go to San Francisco in large numbers and gain as much profit as possible from all phases of the trip. After the journey is planned an effort should be made to find out before going what may be seen en route. Seek reliable and unbiased information expressed in simple language and do not be content merely with the railroad announcements with their superlative descriptions. Often the points of greatest interest and worth to a traveler are not even mentioned by the railways in their advertising matter. There is much to be seen as interesting as scenery and Indians, and equally helpful in geography teaching or as a contribution to one's general information.

An accurate guide book is an essential traveling companion but it should be studied carefully before the start is made so that nothing worth seeing is missed if it can be avoided. Supplement the guide with all the illustrative material available and save all the best descriptive matter for use in the class room or in reminiscing afterwards. An excursion across the country may be a globe trotting jaunt or it may be an education. Forethought and a reasonable amount of preliminary study will make it an education of great worth to all.

GEOGRAPHY MADE EASY

In the present day efforts are being made to develop an "easy" method of teaching geography by following some scheme of organizing the materials so that the geographic character of the items will be obscured. Geography will be acquired most easily, not when it is presented so that it can be temporarily absorbed, but not assimilated, without any effort, but when it is made vital and real and hence obviously worth studying, and presented in such a way that the pupils do not *waste* any effort in their study. It is not possible to make geography easy by adopting some particular "method" of study, for geography, like other subjects, must be taught in different ways at different stages of a pupil's progress. A teacher who follows a "method" shows that she is neither a master of her subject or of the principles of good teaching. A teacher who adapts her ways of presenting a subject to the special problem of the moment is making her "methods" her servants, is teaching her subject well and hence making the later work "easy" because the pupils are being trained for the race to be run.

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REVIEW

AN INTRODUCTION TO PRACTICAL GEOGRAPHY.—By A. T. Simmons and Hugh Richardson. Exercises 218. London and New York: Macmillan and Co., 1905.

AFTER a careful examination of the volume noted above, those most skeptical of the value of geography except as a culture subject must acknowledge its disciplinary character in the best sense of that much abused word.

It is not a "complete" geography. There is practically no descriptive matter, no regional work, nor is it a discussion of subjects usually presented in physical geography. It is a collection of exercises in "practical geography" or an admirable handling of the facts of everyday experience and a marshalling of these facts in such a manner that the underlying principle may be deduced. It trains to close observation, necessitates simple experimentation and requires accuracy of thought and of execution that correct results may be attained.

The exercises are divided into four sections. The first, treatment of maps, the second, of the globe, the third, of climate and the fourth, of certain features of the land and the sea. While the topics presented are similar to those found in the various manuals of physical geography there is a marked difference in treatment. In the volume under discussion much of the work requires true mathematical precision. To illustrate, not only is a careful study of various maps required, as is the case in most manuals, but map making in the field is taught.

The problems are adapted to pupils in the higher grades of the elementary school and to the early years in a high school course. With the younger pupils certain modifications must be made and perhaps some topics eliminated altogether.

The course here presented is in no sense a substitute for that outlined in the geographies generally in use in the upper grades of the elementary school nor for the physical geography of the high school. It should be used, as the authors suggest, in connection with the prescribed course or perhaps as a parallel line of work.

The fact that the book is an English publication, prepared especially for the pupils of the United Kingdom, is in many respects an advantage rather than a detriment as one might at first suppose. It is for this reason, perhaps, more suggestive than the majority of our laboratory manuals of physical geography which have appeared within recent years. The latter

are characterized by a certain uniformity of treatment, valuable perhaps for the co-ordination of the course of study throughout the country, but they fail in freshness and in originality of treatment and are therefore less suggestive than is this "Introduction to Practical Geography."

C. B. K.

RECENT PUBLICATIONS

How We Are Sheltered; A Geographical Reader. By J. F. Chamberlain. pp. viii+184. New York, The Macmillan Company, 1906.

Companion volume to How We are Clothed, How We are Fed, by the same author. Includes chapters on the more striking forms of houses in the world and on the materials used in house construction, lighting and heating. Simple, readable and helpful. Illustrations in general well chosen, but often poorly reproduced so that their value is much lessened. Lacks an index, an unfortunate omission not to be offset by a table of contents.

Maryland. By M. W. Twitchell; New Jersey. By R. H. Whitbeck, being supplementary volumes to accompany the Tarr and McMurry Geographies. Well arranged and valuable for reference beyond the regions for which primarily written. The volume on Maryland is somewhat formal and unindividual. The volume on New Jersey shows the hand of the experienced and suggestive teacher as well as the well trained geographer.

Course of Study and Syllabus for Elementary Schools, published in Supplemental Volume of Annual Report (1905) of Education Department of State of New York, Albany, (1905).

Contains (1) 32-page consideration of geography course, including outline of Home Geography for rural and for city schools. Suggestive and helpful. Includes brief reference lists for pupils and teachers.

(2) Syllabus on Physical Geography for Secondary Schools, 28 pages. A formal and over inclusive outline followed by brief suggestions as to seventy laboratory exercises.

Les Tremblements de Terre, by F. de Montessus de Ballou. pp. 500. Paris, Armand Colin, 1906.

A comprehensive consideration of the features of earthquakes and of their regional distribution. A volume for the expert geographer and geologist.

A Text Book of Commercial Geography, by Cyrus C. Adams. Revised Edition. pp. xvi+506. New York, D. Appleton & Co., 1905.

The revised edition of Adam's popular and reliable Commercial Geography includes a series of review questions at the ends of certain chapters and certain brief additions to the text. The most important map has been brought up to date, statistics have been generally revised, though much more could have been done to advantage in this regard and the latest information in reference to the value of products of the United States has been added as foot notes to the diagrams.

NOTES

SOME OBSERVATIONS ON THE RAISING OF THE MEHARI AMONG THE CHAANBA MOUADHI.—The méhari being but a dromedary of a purer and more refined type, to eliminate entirely the common camel, his brother less favored by nature—would be to deny the parental bonds which unite the two. As they have numerous points in common, we are often led to speak of the camel in a general manner while wishing to make allusion but to the méhari, the object of our study.

A ruminant mammifer, the dromedary or African camel (*camelus dromadarius,* Lin.) is a large and robust animal with a dorsal protuberance, a long, curved neck, and a large callosity (kerkra) on its hind quarters, on which it rests when it is in a recumbent position. It has fleshy toes joined to a common sole, a tail resembling that of a cow, small ears set on a head relatively equally small and great gentle eyes surmounted by high arched eyebrows. Its size varies from 2m 30 to 2m 60. The length of the body, measured from behind the head to the beginning of the tail, attains 3m 50 and even 4 meters in the most highly developed cases. The color most in demand is fawn and tawny yellow; the gray and white are more rare and the latter color is especially prized because of its rarity and beauty. The Arabs maintain that the rough, curly hair among the camels is an indication of great patience.

By his steadiness, endurance and strength, the camel embodies the perfect type of the quadruped created for the desert; an animal most useful for arid regions, it thus plays the most important rôle in the life of the desert dweller. Its existence is closely bound up with that of the nomads of the Sahara; it is not only their beast of burden, carrying merchandise, domestic equipment and provisions, but their munitions of war and travel; nay, even the supplier of their needs, for this animal furnishes the meat and milk for their nourishment, its hide and hair form their tents and other utensils of the first importance for their wandering life.

There are distinct varieties of camels, characterized by certain differences of aptitude and of conformation and consequently by the kind of work which each of them is destined to perform.

These two forms are: the *djemel* or pack camel and the *méhari* or riding camel.

The djemel or pack camel is a heavy, strong beast, the essential elements for caravan transports; he can carry as much as three quintaux; but the ordinary weight of his load is from 150 to 200 kilos; his progress is slow,

with a rather irregular step, because the drivers let their animals walk freely and browse in marching, and varies from two and a half to five kilometers an hour, depending on the character of the land and the action of the driver; it never exceeds this latter and is ordinarily four kilometers an hour.

The méhari, as many authors have said, is to the pack camel, the djemel, what the race horse is to the draught horse. Better made, more svelte and active, it has longer legs, its neck is more slender and its head better formed; its legs are very thin toward the lower part but muscular from ankle to hip; the sole of its foot is small, as well as its hump and tail. The Arabs say of it that "it has the graceful ears of the gazelle, the supple neck of the ostrich and the body of the greyhound."

Our Chaanba Mouadhi do not own such perfect animals. This is due above all to the conditions of their poverty. On the contrary, from time immemorial, the Touareg, who live by pillage, traverse enormous distances in the course of their depredations and are sometimes called to cross, during many days, regions more desolate and without resources than our Sahara.

The instrument of which they avail themselves (the méhari) is adapted to these conditions and these nomads have thus become possessed of mounts of an extraordinary endurance and steadiness. When the méhari chaanbi cannot go without drinking more than four or five days, the méhari targui can last easily twelve or fifteen days. But, as we have said, the reason appears to be that the Chaanba Mouadhi have not asked as much of their beasts as the Touareg.—*Bulletin of the Geographical Society of Algiers.*

THE CIRCUMFERENCE OF THE EARTH.—During the writer's time of service in the New Bedford, Massachusetts, High School, a class in Physical Geography essayed the problem of obtaining the circumference of the earth by the principle of Eratosthenes, as suggested by Davis (Physical Geography, 387). As a collaborating station, Roxbury, Massachusetts, was selected. The results of the exercise were as follows:—

	New Bedford, Mass.	Roxbury, Mass.
Date	Jan 10, 1903.	Jan 10, 1903.
Length of upright	27.3 cm.	6 feet.
Length of shadow	55.2 cm.	12 feet 6 in.
Observer	R. M. B.	I. H. U.

Natural tangent of the angle (sun declination), for New Bedford equaled 55.2 divided by 27.3, or 2.0219; for Roxbury, 12.5 divided by 6, or 2.0833.

These natural tangents yield 63° 41′ in the former case, and 64° 21′ 32″ in the latter.

The difference in sun declination is 40′ 32″.

The distance from Roxbury to New Bedford (measured on the topographic maps, U. S. G. S.) equals 47 miles exactly.

From this data the proportion is as follows:—

$40\frac{32}{60}$:360 :: 47 : x (circumference of earth).

x equals 25,046 miles.

R. M. B.

THE TEACHING OF CLIMATOLOGY AND METEOROLOGY IN THE UNITED STATES.—About 1,000 *graded schools* teach the elements of climatology as a part of geography, receive the daily weather maps, and give talks upon their use in forecasting the weather. About 7,000 *high schools,* or seven-eighths of the whole number, teach the elements of meteorology and climatology in connection with physical geography or physical geology.

The replies to a circular letter recently sent to 177 public normal schools in the United States indicate that in about 25 meteorology and climatology are taught in specific courses; in about 115 these subjects are taught in connection with physical geography or some other allied subject, and in the remaining 37 these subjects are not touched upon.

As to colleges and universities, out of 245 replies 49 state that they have specific courses in meteorology, 95 teach meteorology in connection with some other subjects, and 101 pay no attention to the subject. The corresponding percentages are 20, 39, and 41; probably the replies from other colleges and universities will not alter these ratios very much.

These numerical statistics show that attention to our science has been awakened: in fact, it is receiving a steadily-increasing amount of recognition. In fully one-half of these institutions, from the lower schools to the higher universities, some form of laboratory method is pursued—that is to say, students are required to make personal observations, experiments, and deductions. They study the daily weather map and develop habits of individual thought. In a matter that is so complex as the weather, no text-books can replace the daily map, personal observations, and independent study.—*From a Paper given by Professor Cleveland Abbe before the Association of American Geographers.*

HOW WE TEACH GEOGRAPHY TO-DAY.—There has been vast improvement in the teaching of geography in grammar schools during the last ten years. Evidences of this are:

1. Better courses of study. Compare the courses recently adopted in New York and Chicago, and the suggested course for Boston with the courses arranged ten or fifteen years ago.

2. A more general recognition on part of school superintendents and

other educators that geography is a useful and valuable study, and should receive its proper amount of time and attention.

3. Methods of teaching which are better adapted to the child mind. A different and better arrangement of subjects is followed. In the best schools, observation and reading precede systematic study. Much reliance is placed upon supplementary reading.

4. The use of field and observational work in teaching type forms and other geographical facts instead of definitions, text-books, and even pictures and moulding boards. Classes are taken into the field and shown a real hill, valley, brook, island, etc.

5. Concrete teaching of geography instead of abstract. The "what" is studied first and the "why" afterwards. Facts and results are learned before generalizations are made. The deductive method is largely employed.

6. The stimulation of the imagination of children by their description of journeys and scenes in foreign lands.

7. The prominence given to human geography; that is, study of the people.

8. The attention given to what the people do, and how they get a living; that is, to commercial geography.

9. The use of the eye in teaching geography to-day and less reliance upon memorizing. Globes, maps, and other useful apparatus, pictures, with stereopticon and stereoscope are constantly employed.

10. Topical study of the subject instead of a close following of text-books.

11. Careful consideration and explanation of causal relations.

12. Consideration of the natural activity of the child. He is given plenty of work in making sensible maps, writing imaginative letters from other countries; studying subjects or countries especially assigned to him; in making scrap-books, and compiling home-made geography.

13. The fact that best teachers of geography to-day make the end and aim of their teaching to form five habits or to develop five powers·

a. The observational power or habit.

b. The reading power or habit.

c. The studying power or habit.

d. The reciting power or habit.

e. The reproducing power or habit shown in writing or drawing.

All this may be summed up in the term, "development of geographical expression."

The best and most scientific teaching of geography to-day is undoubt-

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edly found in the normal schools of the country, and credit is due them for the influence they exerted in bringing about the improvement in grammar school teaching.—*American Education, February,* 1906.

HUGE CONSUMPTION OF WOODEN FENCE POSTS.—The difficulty of obtaining fence posts at reasonable prices has given an impetus scarcely realized to forest planting in the Middle West. Newspapers, farmers' institutes, women's clubs, and boards of trade throughout the region are pointing out the need of such material and dwelling on the profit realized by the few men who planted trees years ago and whose plantations have been successful. The local supply of all forest products is insignificant, and timber, if not grown at home, must be imported. With the continuous retreat of the sources of supply under the attack of the vigorous demand, the length of the haul increases and the cost of transportation rises higher and higher. Yet the fields and pastures must be fenced. The posts must be had.

The annual production of fence posts in the regular logging camps of the country, as reported by the last census, is 8,715,661. How many times greater than this is the annual cut from the home woodlot no figures exist to show; but by taking the total number of farms and their acreage and making a conservative allowance for posts for the fences inclosing each farm, it has been estimated that upwards of 1,000,000,000 posts are set each year. Such figures are too vast to mean anything. Even the nine million posts of the Census, a mere drop in the bucket as compared with the unreported production, would, if set 15 feet apart, girdle the earth, or would build a solid pile 55 feet wide, 40 feet high, and a mile long.

Durability and at least moderate strength are the desirable qualities for fence posts. The use of species which are not durable is expensive, both on account of the more frequent renewal which is necessary and because repairing is constantly called for. Timber of the required quality is produced in the Middle West by hardy catalpa, black locust, and Osage orange.

Catalpa makes an excellent growth on deep, porous, fertile soil, but only on such soil. Five or six inch posts should be ready to cut in about ten years. In regions immune from the locust borer, black locust will yield satisfactory returns from soil in which catalpa would fail, and for this reason it is adapted to a wide area where the rainfall is light. Under ordinary conditions, locust should produce fence material in fifteen years.

Osage orange also is not exacting in its soil requirements. It is being extensively planted for hedges and windbreaks, from which a considerable yield of fence posts may be obtained. It makes satisfactory growth on dry soils and reaches post size in from fifteen to twenty years.

Several other species, such as white willow, European larch, Russian mulberry, and red cedar, are also being grown with good results, but none of them is better fitted to supply fence posts than those first named.

The Forest Service fully recognizes the importance of fence posts in farm economy and the great demand for suitable timber. Studies of the growth and durability of various species have been made, and the limits of the commercial planting range of each has been more closely defined. Rapid growing species which are not durable have been studied to determine some form of preservation treatment which will increase their durability. Further work along this line will undoubtedly add largely to the list of species which can furnish the desired product.—*Forestry and Irrigation.*

TIMBER IN ARIZONA.—The treeless areas of the Southwest are so vast that it is difficult to realize that in Arizona, the heart of the "Great American desert" lies the largest unbroken forest in the United States, probably the largest in the world. The forest of yellow pine, flung like a kingly mantle over the rough, mountain-ribbed Mogollon plateau, has given northern Arizona a character and development peculiarly its own.

This great forest covers nearly 10,000 square miles, and stretches, with more or less extended interruptions, from beyond the Grand Cañon on the north and Bill Williams mountain on the west, southward to the great rim where the Colorado Plateau breaks down to the southern plains. It lies at an altitude of from five to seven thousand feet, with fir and spruce and beautiful groves of quaking asp intermingled at the higher levels, and a far-reaching fringe of cedar-covered mesas and hills dropping down to the lower plains and valleys. These cedar forests give much of the picturesque charm and beauty which characterizes the uplands of northern Arizona, and though they have no lumber value are a comfortable wood yard from which the Southwest may draw for generations.—*Out West.*

ECONOMIC GEOGRAPHY.—The study of Economic Geography in the schools is valuable as a means of education in proportion as it gives the pupil a basis for accurate facts and generalizations and develops the power of thinking out the true relations of the economic phenomena that will come to his attention every day of his business life. If this training is thorough and adequate he will be helped by it to look for and determine the causes and effects of facts and experiences that concern him personally, or influence the world's enterprises.

The most significant economic news of the day should therefore be used in the class room to develop the faculty and practice of reasoning out the real meaning of the facts presented. Statements worthy of credence in re-

liable newspapers and other publications may constantly serve to illustrate principles enunciated in the text-book.—*School Century.*

SUN-DRIED BRICKS.—The *adobe* is the salvation of the poor man in Mexico. Lumber is very expensive, stone or brick work is out of the question for him. On the high plateaus where he can neither gather the material for a house in an afternoon from friendly palm trees, and it would not be warm enough if he could, he must fall back upon mother earth for his shelter. The great *adobe* bricks are simply made. The clay is mixed with water and straw, usually the refuse from the stables, pressed into a square wooden frame on the ground to form it and then left to bake in the sun. It is really wonderful how long these bricks will stand the stress of sun and rain in a country where there are no severe frosts. And not alone does the poor man make use of this cheap building material. Many a pretentious wall, that is veneered with a respectable coating of plaster, and finished in imitation of brick or stone, eventually falls into decay and shows that within it has relied for strength and support upon *adobe.—Modern Mexico.*

NEWS ITEMS

The Ninth International Geographical Congress will be held at Geneva, Switzerland, from July 27 to August 6, 1908. A preliminary program will be issued by the committee of arrangements during the current year.

On July 13, at San Francisco, the Department of Elementary Education of the National Educational Association will hold a symposium devoted to the question of How to Teach Geography to Make Pupils Realize the Life Relations.

Papers will be presented on the Constant Attention to the Causal Notion in Class Room Work, by Richard E. Dodge, Professor of Geography, Teachers College; on Illustrative Excursions for "Field Sight"; and on the Emphasis of Commercial and Industrial Geography by Supt. W. N. Clifford, of Council Bluffs, Iowa.

The May number of the JOURNAL will include, in addition to the annual statement of summer school opportunities in geography and geology, a fairly complete selected list of apparatus and equipment available in geography teaching in Elementary and Normal Schools.

The concluding portions of the Oswego Normal School course in Geography will appear in May and June.